

A study on Trans-abdominal ultrasonography in first trimester of pregnancy and its comparison with trans-vaginal ultrasonography

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Abstract

Objectives: Comparison trans-abdominal and trans-vaginal ultrasonography scanning in the study of first trimester of pregnancy, detection of gestational abnormalities and to assess the merits and demerits of trans-abdominal ultrasonography as compared to trans-vaginal technique.

Materials and Methods: A prospective comparative study was conducted on a cohort of 100 female patients in their first trimester of pregnancy. The study population had both normal and abnormal pregnancy patients. The patients were selected on the basis of suspected or proven pregnancies with the duration up to 12 weeks from the last menstrual period. The patients were evaluated on the basis of past obstetrics history and clinical examination, pregnancy test and relevant investigations including ultrasonography. Thus the females with positive pregnancy test, signs and symptoms of threatened abortion or ectopic pregnancy were examined through abdominal and endo-vaginal sonography to compare the two techniques in scanning during the first trimester of the pregnancy and their capability in detection of pregnancy related abnormalities. Either the patient delivered the baby via normal delivery or had undergone surgery and /or pathologic diagnosis was done in all the cases.

Results and Conclusions: 61 cases had a normal intrauterine pregnancy, 25 cases had ectopic pregnancy, 8 had slightly blighted ovum while remaining 6 were missed abortions. All the 61 cases of normal intrauterine pregnancy were detected by trans-vaginal ultrasound while only 13 i.e 21 % were detected by trans-abdominal ultrasound. The yolk sac, foetal pole, fetal heart motion were seen in 36 days with trans-vaginal sonography while it took 45 days with trans-abdominal sonography. In trans-vaginal sonography the fetal motion was seen with crown rump length of 3 mm or more, while for abdominal sonography the length should be at least 6 mm to detect the fetal heart motion. In 25 cases of ectopic pregnancy, five cases had shown a diagnosis of extrauterine sac with fetal pole with fetal heart motion or yolk sac, while trans-abdominal ultrasound could not detect any extrauterine sac. One in each of 8 patients with blighted ovum had gestational sac of 1.9 cm with no fetal pole or yolk sac, it was shown in both the techniques. All the 6 missed abortions were shown in trans-vaginal technique while only 2 were seen through trans-abdominal technique. Thus the findings show that trans-vaginal sonography is more sensitive than trans-abdominal sonography to detect the pregnancy and its complications in the first trimester.

Keywords: Trans-abdominal ultrasound, Trans-vaginal ultrasound, First trimester of pregnancy, fetal development markers.

INTRODUCTION

Ultrasonography is the most important and useful tool that supports the diagnosis and plays a key role in the field of modern science. It is non-invasive, non-hazardous in terms of radiation exposure and it's safe to be used in various investigative procedures. Its unique selling propositions being its convenience, high portability, rapidity and accuracy give ultrasound an advantage over other procedures. In the last few decades it has become essential diagnostic tool in the field of obstetrics and is used extensively for the evaluation of

pregnancy and pregnancy related complications. Ultrasound aids the obstetrician in evaluating fetal growth and development. Improvement in imaging techniques has enhanced the ability to study fetus in the intrauterine environment. Static scan imaging along with real time modalities have complimented the ultrasound study and have accentuated its use in the field of diagnostic imaging.

The standard trans-abdominal ultrasound uses lower frequencies i.e. 3 and 3.5 MHz for imaging of the deeper structures of the body such as pelvic organs. Thus the axial resolution i.e. the ability to distinguish between two separate points in the direct line of ultrasound beam is quite poor. The trans-abdominal ultrasound is used mainly in second and third trimesters of gestation period. Its use is usually diagnostic in nature². With the advancement of technology in recent times the endo-vaginal probe uses the higher frequencies like 5 and 7.5 MHz. The usage of higher frequency trans-vaginal probe and higher resolution images has opened the new possibilities in the early gestation study². Thus the axial resolution has increased as the trans-vaginal probe is placed closed to the pelvic organs as compared to the trans-abdominal transducer. In the first trimester of pregnancy, the trans-vaginal ultrasound permits the detailed observation of the morphology of the early conceptus in utero³.

In terms of ultrasound evaluation of first trimester pregnancy complications, it's concluded that the females presenting with a complaint of bleeding in the first trimester can be wrongly diagnosed with missed abortion or can be inappropriately reassured about viability. With the use of trans-vaginal ultrasound the resolution has improved and has allowed description early embryonic development characteristics⁴.

Thus the first trimester ultrasound also referred as obstetric ultrasound demonstrates the viability, age and maternal health through trans-abdominal and trans-vaginal technique. It also visualizes the uterus and ovaries, corpus luteum cyst, gestational sac, and the embryo⁵.

METHODOLOGY

A prospective comparative study was conducted on a cohort of 100 female patients in their first trimester of pregnancy. The study population had both normal and abnormal pregnancy patients. The patients were selected on the basis of suspected or proven pregnancies with the duration up to 12 weeks from the last menstrual period. The patients were evaluated on the basis of past obstetrics history and clinical examination, pregnancy test and relevant investigations including ultrasonography. Thus the females with positive pregnancy test, signs and symptoms of threatened abortion or ectopic pregnancy were examined through abdominal and endo-vaginal sonography to compare the two techniques in scanning during the first trimester of the pregnancy and their capability in detection of pregnancy related abnormalities. Either the patient delivered the baby via normal delivery or had undergone surgery and /or pathologic diagnosis was done in all the cases. 17 patients had vaginal bleeding with or without pelvic pain, thus suggesting the possibility of threatened abortions. 50 patients had the history of tubal surgery, had undergone treatment with infertility drugs or in vitro fertilization or had signs or symptoms suggestive of ectopic pregnancy. 33 patients were asymptomatic and were studied to determine age of the fetus.

The trans-abdominal ultrasound was done on the moderately distended urinary bladder using real time scanners with low frequency probe i.e. 3/3.5 MHz while the trans-vaginal ultrasound was conducted on the real time sector scanner using high frequency endo-vaginal probe i.e. (5/7.5 MHz) after the patient has voided the urine. The endo-vaginal transducer was covered with a sterile surgical lubricant with before insertion. All the images that were relevant for the study were captured using the multi-format automatic camera. The procedure was explained to the patient was asked to insert the transducer approximately 6-8 cm into her vagina. Coronal and sagittal projections were scanned using a systematic approach that is first the uterus, then adenexa and finally followed by cul-de-sac. The assessment of size and shape of gestational sac and the trophoblastic reaction was done. The growth of the sac was also observed if the patient had a follow up scan. Yolk sacs, fetal poles, blood collections in and around the sac, and the amniotic membrane were also evaluated for the study. The average of longitudinal, antero-posterior and transverse dimensions were determined to calculate the mean sac diameter. The sac was measured from the inside of the sac to the inside of the decidual reaction but the decidual reaction was taken in the measurement. The sac wall was checked for the double decidual reaction in case of early intrauterine pregnancy while the decidual cast in case of ectopic pregnancy. The presence of decidual cast was considered when a ring like structure containing fluid was

observed with a single echogenic outline. All the patients were observed for the evidence of any ectopic pregnancy or any other adenexal disease.

Two radiologists had interpreted the sonograms. While performing trans-vaginal sonography the results of trans-abdominal studies were already known. The final diagnosis was made either by surgical and pathological correlation and or by follow up scans to confirm the presence of normal intrauterine pregnancy. Of all the 61 patients with normal intrauterine pregnancies, the patients whose ultrasound showed a double decidual outline, only a yolk sac and fetal poles in which the fetal heart motion was not recognised had follow up scans to establish the growth of the fetal pole and to observe the presence of fetal heart motion. (Table 1)

Table 1: Sonography findings seen in Normal Early Intrauterine and Ectopic pregnancy

| Type of pregnancy: Findings | No. of cases: Trans-abdominal | No. of cases: Trans-vaginal | Total number of cases |
|--|-------------------------------|-----------------------------|-----------------------|
| Normal early Intrauterine pregnancy (n=61) | | | |
| Double decidual reaction | 2 | 6 | 8 |
| Yolk sac seen | 3 | 9 | 12 |
| Fetal pole seen | 7 | 34 | 41 |
| Heart motion | 4 | 33 | 37 |
| Ectopic pregnancy (n=25) | | | |
| Ectopic fetal pole and yolk sac | 0 | 4 | 4 |
| Decidual cast ^a | 3 | 6 | 9 |
| Prominent endometrial cavity ^b | 3 | 7 | 10 |
| Normal uterus ^c | 8 | 5 | 8 |
| Adenexal ring ^d | 10 | 6 | 16 |
| Adenexal mass | 2 | 3 | 5 |
| Hepatosalpinx | 0 | 2 | 2 |
| Normal adenexa | 6 | 3 | 9 |
| Cul-de-sac fluid | 9 | 12 | 21 |
| Intra-abdominal fluid | 4 | 0 | 4 |

- Fluid collection in the endometrial cavity with a thick echogenic border
- Echoes with a width more than 6mm in the endometrial cavity
- In 8 patients with ectopic pregnancy, the uterus was of normal size with linear endometric echo on trans-abdominal sonogram. Of these eight, transvaginal sonograms had shown a normal uterus in 5, but endovaginal sonograms showed thick endometrial echoes in the other 3.
- A cyst with an echogenic ring in the adenexa

Amongst the patients with ectopic pregnancies, in 4 cases the diagnosis was made using trans-vaginal sonography by visualizing the yolk sac and fetal pole in the gestational sac located in the adenexa and uterus was empty. While for the remaining cases, the sonographic diagnosis of ectopic pregnancy was made by empty uterus, adenexal mass, adenexal ring or hematosalpinx. The final diagnosis amongst all the cases was done surgical exploration and confirmation via pathologic investigations.

RESULTS

Out of the 61 cases of very early intrauterine pregnancy, there were 2 cases that had shown double decidual line around the gestation sac in the trans-abdominal scan, while there were 6 cases that had shown gestation sac with dual decidual lining in trans-vaginal scan. The double lining was seen early in the trans-vaginal scan when the gestation sac was 0.7 cm while in trans-abdominal scan the dual lining was seen when the gestation sac had reached the size of 1 cm.

Both transabdominal and transvaginal scans had shown yolk sac in 3 patients, whereas in 9 cases it was seen only in trans-vaginal scan. In trans-abdominal scan the gestation sac with size 1 cm or larger had shown the

image of yolk sac while trans-vaginal sonography scan had shown the yolk sac when the gestation sac was only 0.8 cms or larger in size.

Fetal poles were observed in 41 cases. In 7 cases, the fetal poles were seen via trans-abdominal sonography while in 34 cases the fetal poles were seen in trans-vaginal sonograms. The crown rump length was 3-5 mms in these 34 cases. The trans-abdominal scan in these cases had shown an empty gestation sac, along with only a yolk sac or an indistinct linear echo suggestive of fetal pole in these cases. In the 7 cases where the fetal pole was observed both trans-abdominally and trans-vaginally the crown rump length was 6 mm or more.

Fetal heart motion was seen in 37 cases. Only 4 cases had shown heart motion in trans-abdominal sonography whereas 33 cases had shown fetal heart motion in trans-vaginal sonography. Out of the 41 cases with fetal poles only 37 had shown heart motion. The remaining 4 cases had crown rump length of less than 0.2 -0.3 cm. There were three patients whose gestation sac was shown empty in the trans-abdominal ultrasound while the trans-vaginal sonogram had shown twin gestations. Yolk sacs, fetal poles along with fetal heart motion were present, it corresponded to the gestational age of 5.9 weeks. 25 ectopic pregnancies were confirmed during the study, (Table 1). Only 4 cases were confirmed by trans-vaginal sonogram. The scan showed a trophoblastic reaction surrounding amniotic cavity having a yolk sac and a fetal pole with heart motion. A decidual cast was seen in 3 cases under trans-abdominal sonography, while 6 cases observed via trans-vaginal scan showed a decidual cast. Total 10 cases had shown endometrial echo texture which was 6-7 mm wide but there was not any promising anechoic center. It was seen in 3 cases via trans-abdominal ultrasound and additionally in 7 cases that had undergone trans-vaginal scan. In 8 cases with ectopic pregnancy, normal uterus with linear endometrial echoes are seen during trans-abdominal sonography, amongst these 8 the 5 had shown normal uterus while others had 3 cases had shown thick echogenic texture (more than 6 mm wide) in trans-vaginal sonography. A circular ring of echoes that surrounds an echogenic space located in the adenexa was named as an adenexal ring. An adenexal ring was seen in 10 cases in trans-abdominal scan and an additional 6 patients in trans-vaginal scan. A solid adenexal mass with mixed echogenicity was seen in 2 cases trans-abdominally whereas in 3 cases in trans-vaginal scan. In 6 cases normal adenexa was seen on trans-abdominal examination. In 3 of these cases normal adenexa was seen trans-vaginally, remaining 3 cases had shown adenexal rings in the 2 cases while in 1 case oblong hypoechoic tubular structure was seen. This structure was thought as the distended tube filled with blood. Amongst these 6 cases two cases had shown a fetal pole with fetal heart motion in ectopic location, while in other 4 cases the ectopic pregnancy was diagnosed at the time of surgery. Cul de sac fluid was seen in 9 cases through trans-abdominal scan and in 12 cases trans-vaginal sonography. A generalized hemoperitoneum was demonstrated only in trans-abdominal sonogram. The trans-abdominal sonography scan had shown irregular uterine mass while trans-vaginal scan showed a uterus surrounded by an echogenic fluid like blood which gives a pseudouterine appearance. The cul-de-sac and flanks had irregularly shaped echoes because of partly liquid and partly clotted blood. Apart from this elsewhere in abdomen the hemoperitoneum was seen as a clear and anechoic free fluid in peritoneal cavity when examined via trans-abdominal scan.

Out of 24 cases with nonviable pregnancies i.e. fetal pole with no heart motion, 11 cases had blighted ova while 13 of them had an early embryonic demise making them the case of missed abortions. In the 6 of 11 cases of blighted ova, the smallest mean sac diameter was 1.2 cm and lacked an embryo. The remaining 5 cases had shown the smallest mean sac diameter of 0.9 cm had lacked the yolk sac. The observation for blighted ova was made in the follow up examination. In the 8 of 13 cases of early embryonic demise or the missed abortions, both the trans-abdominal and trans-vaginal sonograms had shown an irregular clump of echoes. The absence of heart motion was confirmed with the trans-vaginal ultrasound. In another 5 cases of missed abortions the fetal pole with crown - rump length of 0.8-0.9 cm without and fetal heart motions was seen in both trans-abdominal and trans-vaginal ultrasounds. In one of them a large haemorrhage was also seen around the gestation sac during the trans-vaginal sonography. No other information was provided by the endo-vaginal scan in these 5 cases.

DISCUSSION

The "double decidual sign" was seen in trans-vaginal sonography when the sac size was 0.5-0.7 cm while in trans-abdominal scan it was difficult to detect the sign when the sac was smaller than 1 cm. The double sac appearance can be identified during the approximate fetal age of 2 to 7 weeks after the conception. It appears

when the decidua capsularis makes a common boundary with decidua wa parietalis thus obliterating the space between them. This finding was consistent with the study by Nyberg DA, Laing FC, Filly RA, and Margaret US. Jeffery RB: Ultrasonographic differentiation of the gestational sac of early intrauterine pregnancy from the pseudo gestational sac of ectopic pregnancy⁶.

The yolk sac in the gestation sac can be demonstrated with trans-vaginal sonography when the sac size is 0.6-0.9 cms, while in trans-abdominal sonography the yolk sac was not seen until the gestation sac reached at least 1 cm. Fetal pole was detected in trans-vaginal sonography when the sac size ranged between 0.7-1.2 cms, mean sac size being 0.9 cm corresponding to 4.3 to 5.3 weeks of gestation. Fetal heart motion was detected consistently when the fetal pole measured 0.4 cm or more and it was detected occasionally when the fetal pole measured as small as 0.2 cm. The same observation was seen the study by Pennell RG, Oksana HB, Kurtz AB, *et al*. Complicated first-trimester pregnancies⁷.

The trans-vaginal ultrasound has the ability to detect fetal heart motion at this early stage of pregnancy has considerable practical value. The diagnosis of live intrauterine pregnancy generally excludes the ectopic pregnancy, except in the rare circumstances when both of them co-exist, as shown in the study by Hann LE, Bachman DM, McArdle CR. Coexistent intrauterine and ectopic pregnancy: a re-evaluation⁸. When the fetal heart motion is demonstrated in a scan gives a probability of favourable prognosis as many trans-abdominal studies have shown that 90% of the live intrauterine pregnancies remain viable and they do not get aborted, as shown in the study by Dull GB, Evans JJ, Legge M. A study of investigations used predict outcome of pregnancy after threatened abortion⁹. With increasing number of ectopic pregnancies the trans-vaginal approach is the faster way for the detection of ectopic pregnancy. This provides the faster detection of ectopic pregnancies surpassing the diagnostic delays caused by the standard clinical approach of performing tests like beta HCG and trans-abdominal ultrasound. The data also shows that the trans-vaginal sonography provides the more definitive diagnosis of ectopic and intrauterine pregnancy because of its higher frequency transducers. In trans-vaginal scans the detection of extra-uterine gestation sac and fetal pole is three times more often than the trans-abdominal approach. To recognise and differentiate between double echogenic ring of intra-uterine pregnancy and the single ring of decidual cast of an ectopic pregnancy, to identify the adenexal ring, and the visible distension of fallopian tube with blood are the indirect features that are seen more frequently with trans-vaginal sonography. Another indirect feature of ectopic pregnancy shown by trans-vaginal sonography was the adenexal mass with fluid around it whereas trans-abdominal scan had shown normal appearing adenexa. The trans-vaginal scan showing no intrauterine gestational sac gave the confidence to the radiologist in diagnosing empty uterus in case of ectopic pregnancies. This observation correlates with Pennell RG, Oksana HB, Kurtz AB, *et al*. Complicated first-trimester pregnancies⁷. With the use of trans-vaginal scans the sensitivity of ultrasonography has increased in diagnosing the threatened abortions, as fetal heart motion is observed as soon as the fetal pole is visible. The presence of yolk sac is also seen earlier in trans-vaginal scans than the trans-abdominal ones.

A diagnostic dilemma occurs when a gestation sac is seen in sonogram and it lacks an embryo. It occurs in the normal pregnancy before the sonographic detection of embryo i.e. 5- 7 weeks of gestation age or in a non-viable pregnancy where either the embryo died or it was a case of un-embryonic pregnancy where it was not developed at all. Various criteria were developed to distinguish between the early intrauterine pregnancy or a blighted ovum. In trans-abdominal scan if the sac is larger than 2.5 cm in diameter and does not have the fetal pole or yolk sac it considered as non-viable. This criterion is also used for diagnosis of blighted ovum when observed through trans-abdominal scan. While during trans-vaginal scan the sac ranging from 1-1.7 cm and the embryo was not seen it was diagnosed as blighted ovum as shown by the criteria developed by Nyberg DA, Laing FC, Filly RA. Threatened abortion: sonographic distinction of normal and abnormal gestation sacs¹⁰.

CONCLUSION

Results show that transvaginal sonography is more accurate in detection of abnormalities in the first trimester of pregnancy. Early intrauterine pregnancies were detected quite easily with trans-vaginal than the trans-abdominal scan. Other advantages of trans-vaginal sonography are that patients do not have to be uncomfortable and wait till their bladders are full and it is also time saving. Transvaginal sonography also shows better results

in case of obese patients, in patients with retroverted uterus and the obstacles like bone, gas filled bowel and extensive pelvic adhesions are also bypassed¹¹.

Apart from all the advantages of the trans-vaginal scans, they do have limitations like a global view of uterus and pelvis cannot be obtained with the scans, the lesions located too high in pelvis or outside the pelvis cannot be visualized. However there are no cases in the study where the trans-vaginal scans had shown a false positive diagnosis. Thus it also states that combination of trans-abdominal and trans-vaginal ultrasound works best in terms of diagnosis. Trans-vaginal sonography cannot be the substitute but it works as a conjuncture with trans- abdominal sonography, thus leading to better visualization, improved diagnosis and ultimately better management of the patients¹².

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